

## Jubaea, The Palm of Chile and Easter Island? \*

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### Introduction

In two different expeditions, Heyerdahl and Ferdon (1961) and John Flenley (1984) found outstanding amounts of palm tree pollen in the crater sediment of Rano Raraku and Rano Kau, Easter Island. The microscopic analysis of this fossil pollen shows a great similarity to fresh pollen of *Jubaea chilensis* (Molina) Baillon. Both measure about 40 x 20 microns and have similar membrane structure (Figure 1).



Figure 1. Fossil pollen of Easter Island (top) compared to four pollen grains of *Jubaea chilensis*.

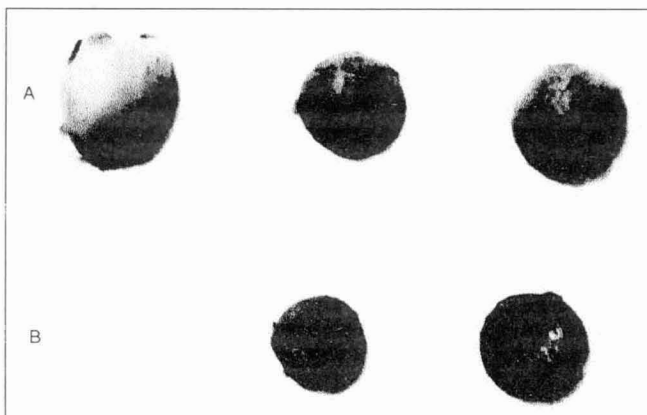


Figure 2. Coconuts of *Jubaea chilensis* compared to endocarps found on Easter Island. A) fresh fruits; B)

On the other hand, Dransfield (*et al.*, 1992) described ancient coconut endocarps that were found for the first time

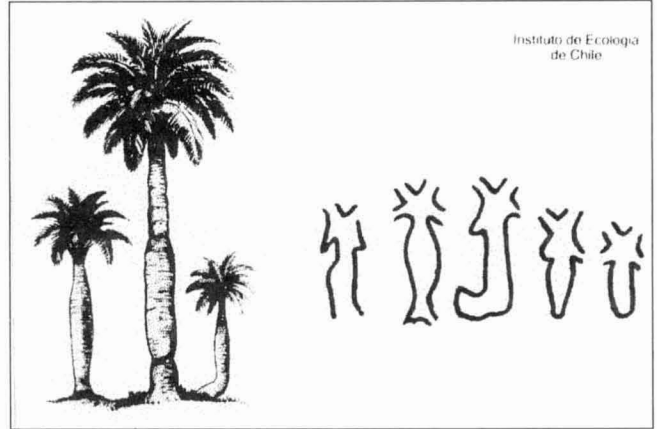


Figure 3. Similarity of *Jubaea* palm with *rongorongo* signs "niu" the Polynesian name for coconut tree.

by French speleologists in Ana o Keke; these are closely related to those of *Jubaea* (Figure 2).

There are many other arguments given by Bahn and Flenley (1992) but one that provides the most suggestive

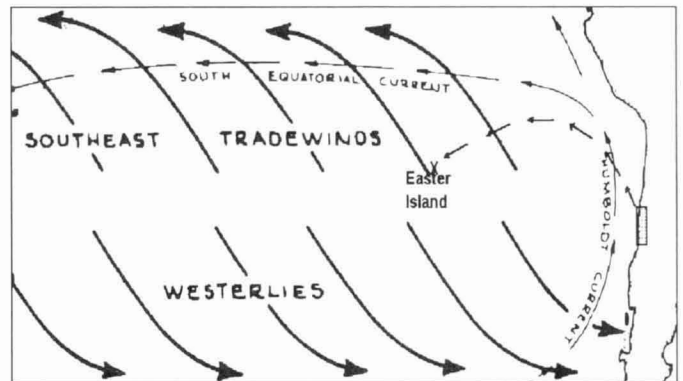


Figure 4. Possible sea route for the dispersion of *Jubaea* seeds via ocean currents (map after Finney 1994).

evidence is the similarity of the *rongorongo* sign "niu" (meaning palm tree) as compared to the shape of *Jubaea* (Figure 3).

Starting from this premise, we will try to support the hypothesis that Easter Island was populated with palm trees until the first part of the present millennium, and also we will try to demonstrate the possibility of the dispersion of Chilean palm seeds, carried along into the Pacific by the Humboldt and Equatorial Currents, from the palm groves of the Coastal Range of South America. We will first prove their floatability and then their vitality after four months in the ocean (Figure 4).

## TAXONOMIA DE LA PALMA CHILENA

Division	: ESPERMOPHITA
Subdivision	: MAGNOLIOPHITINA o ANGIOSPERMAS
Clase	: LILIATAS o MONOCOTILEDONEAE
Subclase	: ARECIDAE o SPADICIFLORAE
Orden	: ARECALES o PRINCEPIES
Familia	: ARECACEAE o PALMAE (3400 especies)
Tribu	: COCOEAE
Subtribu	: BUTIINAE
Género	: JUBAEA

Especie : *Jubaea Chilensis* (Molina) Baillon  
*Jubaea Spectabilis* (HBK)

Habita hasta el paralelo 36 (Rhopalostylis sp. y Kentia sp. hasta el paralelo 37 en N.Z.) S.

Juba : de Juba Rey de Numidia (52 AC-18 DC)

Juba : en español Penacho (Tuft)

HBK = Humboldt, Bonpland y Kunth.

Figure 5. Taxonomy of the Chilean palm (Juan Grau, Instituto de Ecología de Chile).

### Prehistory

A) Fossil palm seeds and palm wood have been found in the province of Rio Negro (Argentina) near the village of General Roca; and it is possible to find fossils of small coconuts and also palm wood, probably from the Tertiary era. B) In Concepción, Chile, Phillippi described a Tertiary fossil of small coconuts in association with sea shells (*Turritella* sp.).

### History

The Chilean palm appears in documents of the early Spanish colony, which mention that the coconuts of *Jubaea* were used as food by the natives. Many places in Chile have the place-name of Palma, or Las Palmas and, since the 18th century, the palm was used for honey production.

### Taxonomy of the Chilean Palm

Humboldt, Bonpland and Kunth called this palm *Jubaea spectabilis*; Molina and Baillon called it *Jubaea chilensis* (Figure 5).

### Actual habitat of *Jubaea chilensis*

In Chile from the IV Region (30° South parallel) to the VII Region (36°S. parallel); it is possible to find groups of palms in their natural environment. Planted in urban plazas and parks, very old specimens grew in towns up to the 40° S. parallel. In Valparaíso, the palms grow very close to the seacoast and some eighty thousand palms at Ocoa are 4 km from the Aconcagua River. Most wild palms share their habitat with the *sclerophyll* bush in the Coastal

Range, and range from sea level to 2000 meters in altitude (Figure 6).

Rocky soil is preferred by *Jubaea*. In the north, *Jubaea* shares its habitat with two species of mountain rat: *Abrocoma benetti murrayi* and *Otodon degus*. Both species pierce the coconuts, break the woody endocarp, and eat part of the endosperm. According to University of Chile studies, the actions of these rodents induce germination of the embryo. Cattle often eat the mature fruit, dropping nuts into the soil. The process of digestion softens the endocarp and helps the seed to germinate.

As cattle are new elements in the natural history of the *Jubaea* palm, this function could have been assumed by the *Camelidae*s (guanacos, llamas, etc.) and deer (*cervus*); these were abundant prior to the arrival of Europeans

### Structure of the fruit

The fruit of the *Jubaea* is a drupe containing the endocarp, woody endocarp, the endosperm cover with a membrane (testa) and the endosperm containing the embryo. The juicy part of the fruit, the ectocarp, is soon eaten by rodents, insects, and fungus and is so destroyed. The woody endocarp retards, but does not prevent, the entering of water into the endosperm and embryo as was demonstrated by Lilian Infante and colleagues (1989), using fresh water. But no experiments were made using sea water which is hypertonic in relation to the liquid of the fruit.

### Floating experiment of the *Jubaea* fruit

We performed our research with 500 fresh coconuts from the same group of palms at Cocolán. One hundred of these were kept in a nylon net floating on the sea water of the Pacific Ocean at the Bay of Algarrobo (30 km south of Valparaíso) (Figure 7). The rest of the coconuts were kept in sea water in three different containers. After four months, about 20% of the coconuts in each group were still floating.

	NOMBRE	LUGAR PROVINCIA REGION	DISTANCIA AL OCEANO PACIFICO	DISTANCIA AL RIO MAS CERCANO	Nº DE ARBOLES ADULTOS
1	LIMAHUIDA TILAMA	Los Vilos IV Reg.	32 km	R. Choapa 4 km	500
2	PEDEHUA	Victoria V Reg.	34 km	R. Petorca 2 km	500
3	PALMAR DE OCOA	Parq. La Campana V Reg.	47 km	R. Aconcagua 4 km	80,000
4	PALMAR DE LLAY LLAY	San Felipe V Reg.	60 km	R. Aconcagua 2km	1,500
5	PALM. AGUA SANTA EL SALTO	Valparaíso V Reg.	5 km	—	1,500
6	PALMERIAS LOS GUINDOS	Melipilla R. Met.	65 km	R. Maipo 20 km	5,000
7	PALMERES DE COCALAN	Las Cabras VI Reg.	80 km	R. Cachapoal 15 km R. Rapel 25 km	35,000
				TOTAL DE ARBOLES	124,000

Figure 6. Actual geographical distribution of *Jubaea*.

In order to find and explain the floating capacity of the fruit, we performed the following studies.

#### A) Radiography

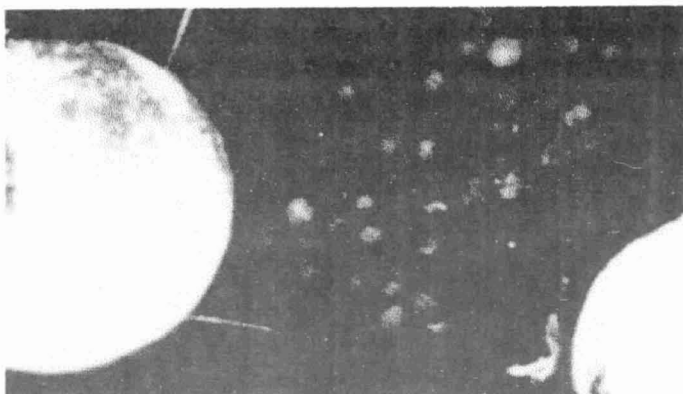


Figure 7. 100 coconuts floating in the Pacific Ocean at Algarrobo, Chile. The large objects are floats.

Some of the fruits were X-rayed, showing a layer of air between the testa of the endosperm and the woody endocarp in the fresh and dry coconuts. Both floating and sunken fruits lost the air layer and it was not possible to find another radiological difference between them (Figure 8).

#### B) Histological Morphology\*\*

In the pericarp, the soft part of the drupe, it is possible to find tiny spaces of air called schizogenic, similar to the tissues of aquatic plants. In the woody endocarp it is possible to observe the sclereid cells (stone cells) with a central air vacuole surrounded by lignite fibrotic material; this particularity is also common among aquatic plants (Figure 9).

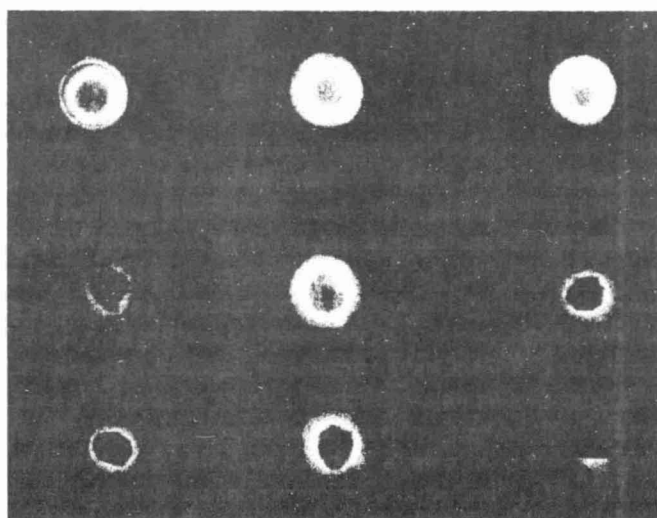


Figure 8. Radiography of the Palm seeds showing an air layer in three coconuts.

#### Test of Vitality \*\*\*

Using the TFT test, Chloride of 2, 3, 5, triphenyl tetrazolium, it was possible to demonstrate the level of the respiratory activity of the embryos. The seeds immersed in sea water showed a high percentage (90%) of tissue vitality

that was not only qualitative but quantitative, displaying high pigmentation of the endosperm and especially of the embryos (Figure 10).

#### Conclusion

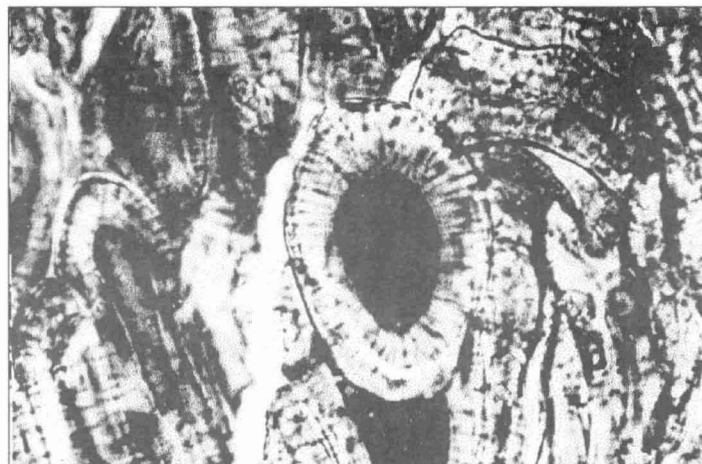


Figure 9. Histology of the endocarp showing the esclerocid cells with a central air vacuole.

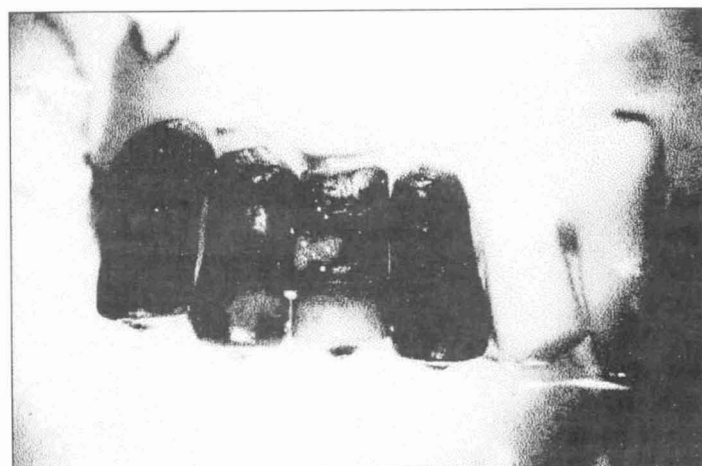


Figure 10. Test of "TFT" showing the pigmentation of the embryos (except the one shown on far right).

In this preliminary paper, it is possible to firmly support the hypothesis that the seeds of *Jubaea* were transported naturally by floating in the sea from Chile to Easter Island. The great amount of *Jubaea* palms on the Chilean coast before and during historic times permits us to accept the possibility that thousands of seeds could reach the Pacific Ocean and migrate long distances, carried to the west by the Humboldt and Equatorial Currents.

The comparison of the pollen and coconuts of *Jubaea* with the pollen and endocarps found on Easter Island shows a great similarity. The floatability of 20% of the seeds in sea water and the conservation of their vitality after four months encourages us to continue research in this line of investigation.

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- \*\* With assistance of Prof. Gloria Montenegro and Ana M. Mujica, Chair, Vegetal Morphotaxonomy, Dept. of Ecology, Catholic University of Santiago.
- \*\*\* With assistance of Prof. Juan Veloso and Luis Gonzalez, Chair of Vegetal Fisiology, Dept. Of Ecology (Prof. Miguel Jordan), Catholic University of Santiago.



This landscape could have been familiar in Easter Island 1000 years ago.

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